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REPORT NO. 95-08

PLASTIC PALLET PRODUCED BY ALKET INDUSTRIES MIL-STD-1660 TESTS

Prepared for:
U.S. Army Armament Research, Development and Engineering Center
ATTN: AMSTA-AR-ESK
Rock Island, IL 61299-7300

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VALIDATION ENGINEERING DIVISION
SAVANNA, ILLINOIS 61074-9639

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The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), AMSTA-AR-ESK, to conduct MIL-STD-1660 tests on a plastic pallet made with blended recycled high-density polyethylene produced by Alket Industries (formerly Aldan Lane Company). The pallet initially failed to meet MIL-STD-1660, Design Criteria for Ammunition Unit Loads, requirements; however, after several pallet modifications, the polyethylene pallet loaded with simulated 105mm boxed ammunition met MIL-STD-1660 requirements. This report contains the test results.

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SAVANNA, IL 61074-9639

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PLASTIC PALLET PRODUCED BY ALKET INDUSTRIES MIL-STD-1660 TESTS

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), AMSTA-AR-ESK, to conduct MIL-STD-1660 testing on a blended recycled high-density polyethylene pallet made by Alket Industries, Kalona, IA.

B. AUTHORITY. These tests were conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

C. OBJECTIVE. The objective of these tests was to ascertain that the pallet constructed of blended recycled high-density polyethylene meets MIL-STD-1660, Design Criteria for Ammunition Unit Loads, requirements.

D. CONCLUSION. The polyethylene pallet loaded with simulated 105mm boxed ammunition failed MIL-STD-1660 tests several times. Each time, the pallet was modified to correct the failure. Following a series of modifications, the pallet passed MIL-STD-1660 tests at ambient temperature and hot and cold soak tests. These modifications include a steel strip attached to each skid, flat-headed turnbuckles extending from the top of the stringer board through the block to the bottom of the skids, and screws through the steel strip into the skid between the blocks.

PART 2

16 MARCH 1995

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PART 3

TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is to be considered acceptable. The four tests that were conducted on the test pallets are summarized below. Upon successful completion of these tests at ambient temperature, the testing was repeated with the palletized unit load exposed to soak temperatures of -40 degrees Fahrenheit and 140 degrees Fahrenheit.

A. STACKING TEST. The unit load was loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load was simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. The compression load was calculated in the following manner. The unit load weight was divided by the unit load height in inches and multiplied by 192. The resulting number is the equivalent compressive force of a 16-foot-high load.

B. REPETITIVE SHOCK TEST. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure was as follows: The test specimen was placed on, but not fastened to, the platform. With the specimen in one position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency was achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieved 1 +/- 0.1 Gs. Midway into the testing period the specimen was rotated 90 degrees and the test continued for the duration.

Unless failure occured, the total time of vibration was two hours if the specimen was tested in one position; and, three hours for more than one position.

C. EDGEWISE ROTATIONAL DROP TEST. This test was conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise rotational drop test was as follows: The specimen was placed on its skids with one end of the pallet supported on a beam 4-1/2 inches high. The height of the beam was increased if necessary to ensure that there was no support for the skids between the ends of the pallet when dropping takes place, but was not high enough to cause the pallet to slide on the supports when the dropped end was raised for the drops. The unsupported end of the pallet was raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection conformed to the following tabulation:

GROSS WEIGHT NOT EXCEEDING (Pounds)	DIMENSIONS ON ANY EDGE NOT EXCEEDING (Inches)	HEIGHT OF DROP LEVEL A PROTECTION (Inches)
600	72	36
3,000	no limit	24
no limit	no limit	12

D. INCLINE-IMPACT TEST. This test was conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline impact test was as follows: The specimen was placed on the carriage with the surface or edge which was impacted projecting at least 2 inches beyond the front end of the carriage. The carriage was brought to a predetermined position on the incline and released. If it is desired to concentrate the

impact on any particular position on the container, a 4- by 4-inch timber is attached to the bumper in the desired position before the test. No part of the timber was struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges are subjected to impacts is at the option of the testing activity and will depend upon the objective of the tests. This test was to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen was subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact was 7 feet per second.

E. HOT SOAK TEST. The procedure for the hot soak test was as follows: The specimen was exposed to a soak temperature of 140 degrees Fahrenheit for a period of time sufficient to allow the specimen to completely soak. The pallet was removed for the compression test. Upon completion, the pallet was again exposed to a temperature of 140 degrees Fahrenheit until a complete soak was obtained. The process was repeated for both orientations of repetitive shock testing, the edgewise rotational drop test, and the incline-impact test. Each of these tests require the specimen to meet the same standards required for testing at ambient temperatures.

F. COLD SOAK TEST. The procedure for the cold soak test was as follows: The specimen was exposed to a soak temperature of -40 degrees Fahrenheit for a period of time sufficient to allow the specimen to completely soak. The pallet was removed for the compression test. Upon completion, the pallet was again exposed to a temperature of -40 degrees Fahrenheit until a complete soak was obtained. The process was repeated for both orientations of repetitive shock testing, the edgewise rotational drop test, and the incline-impact test. Each of these tests require the specimen to perform to the same standards required for testing at ambient temperatures.

PART 4

TEST EQUIPMENT

A. POLYETHYLENE PALLET WITH 3/4-INCH SKIDS (Test Sample No. 1).

1.	Manufacturer:	Alket Industries
2.	Design Criteria:	MIL-P-15011
3.	Pallet Material:	Blended Recycled High-Density Polyethylene
4.	Skid Form:	Extruded Sheet
5.	Block Form:	Extrusion Flow Mold
6.	Deck Material:	Extruded Sheet
7.	Width:	35 inches
8.	Length:	45-1/2 inches
9.	Height:	5-1/2 inches
10.	Weight Loaded:	3,875 pounds
11.	Height Loaded:	45-1/2 inches
12.	Pallet Load:	Boxed Ammo, 105mmCartridges

B. POLYETHYLENE PALLET WITH 1/2-INCH SKIDS WITH METAL STRIP (Test Sample No. 2).

1.	Manufacturer:	Alket Industries
2.	Design Criteria:	MIL-P-15011
3.	Pallet Material:	Blended Recycled High-Density Polyethylene
4.	Skid Form:	Extruded Sheet
5.	Block Form:	Extrusion Flow Mold
6.	Deck Material:	Extruded Sheet
7.	Width:	40 inches
8.	Length:	48 inches
9.	Height:	5-1/2 inches
10.	Weight Loaded:	3,955 pounds
11.	Height Loaded:	55-1/2 inches
12.	Pallet Load:	Boxed Ammo, 105mmCartridges

C. POLYETHYLENE PALLET WITH OAK SKIDS (Test Sample No. 3).

1. Manufacturer: Alket Industries
2. Design Criteria: MIL-P-15011
3. Pallet Material: Blended Recycled High-Density Polyethylene
4. Skid Material: Oak
5. Block Form: Extrusion Flow Mold
6. Deck Material: Extruded Sheet
7. Width: 40 inches
8. Length: 48 inches
9. Height: 5-1/2 inches
10. Weight Loaded: 3,875 pounds
11. Height Loaded: 56 inches
12. Pallet Load: Boxed Ammo, 105mmCartridges

D. POLYETHYLENE PALLET WITH 1/2-INCH SKIDS WITH METAL STRIP (Test Sample No. 4).

1. Manufacturer: Alket Industries
2. Design Criteria: MIL-P-15011
3. Pallet Material: Blended Recycled High-Density Polyethylene
4. Skid Form: Extruded Sheet
5. Block Form: Extrusion Flow Mold
6. Deck Form: Extruded Sheet
7. Width: 40 inches
8. Length: 48 inches
9. Height: 5-1/2 inches
10. Weight Loaded: 3,875 pounds
11. Height Loaded: 55-1/2 inches
12. Pallet Load: Boxed Ammo, 105mmCartridges

E. COMPRESSION TESTER.

1. Manufacturer: Ormond Manufacturing
2. Platform: 60 inches by 60 inches
3. Compression Limit: 50,000 pounds
4. Tension Limit: 50,000 pounds

F. TRANSPORTATION SIMULATOR.

1. Manufacturer:	Gaynes Laboratory
2. Capacity:	6,000-pound pallet
3. Displacement:	1/2-inch amplitude
4. Speed:	50 to 400 rpm
5. Platform:	5 by 8 foot

G. INCLINE-IMPACT PLANE.

1. Manufacturer:	Conbur Incline
2. Type:	Impact Tester
3. Grade:	10 percent incline
4. Length:	12 foot

PART 5

TEST RESULTS

TEST OBSERVATIONS. Several pallet modifications were tested before a blended recycled high-density polyethylene pallet loaded with simulated 105mm boxed ammunition successfully completed MIL-STD-1660 tests. On the first pallet, the skids melted and the screws sheared off. The second polyethylene pallet was manufactured with larger screws and 1-1/2-inch steel strip under each polyethylene skid. This pallet met MIL-STD-1660 criteria at ambient temperature. A third polyethylene pallet was manufactured with larger screws than the first pallet and contained oak skids. This pallet also passed MIL-STD-1660 tests at ambient temperature.

MIL-STD-1660 tests were performed on the second pallet with the pallet being exposed to a heat soak prior to each test. The screw connecting the deck to the blocks pulled out. A flat-headed turnbuckle extending from the top of the deck through the skids was inserted in place of the screws through the deck into the blocks. The pallet passed the heat soak. The polyethylene skids of the pallet bowed while the metal strip connected to the skid remained flat, creating a 3/4-inch gap. A fourth polyethylene pallet was manufactured. This pallet had flat-headed turnbuckles from the bottom of the skids to the top of the stringer board at each polyethylene block. The pallet also included one screw connecting the steel strip and the polyethylene skid between each set of posts. Following completion of cold testing, the load was removed from the pallet and a broken deck board was noted. Prior to removal of the board, the pallet was exposed to extreme heat. It was noted that the additional screws in the skids reduces the gap between the skid and the metal strip to less than 1/4-inch while in hot soak. The broken board was replaced and the pallet passed cold testing.

TEST SAMPLE NO. 1:

A. SUPERIMPOSED LOAD TEST. The test polyethylene pallet was initially loaded to 16,900 pounds compression. The compression was released after one hour. No damage was noted during this test.

B. REPETITIVE SHOCK TEST. The duration of the test was 90 minutes for each orientation of the pallet. For the lateral orientation, the transportation simulator was initially set for 186 rpm. After 35 minutes had elapsed, friction had created enough heat to cause the polyethylene skids to begin to melt. Steel strips were attached to the bottom of the polyethylene skids. The pallet was placed in a lateral orientation on the vibration table at 150 rpm for 90 minutes. This time no damage was noted. The transportation simulator was set at 240 rpm for 90 minutes with the pallet in the longitudinal orientation. No damage was noted.

C. EDGEWISE ROTATIONAL DROP TEST. One side of the pallet was placed on a beam displacing it 4-1/2 inches above the floor. The opposite end of the pallet was raised to a height of 12 inches, then dropped. While lifting the pallet for the second drop, the center post came loose from the skid and the pallet deck. The screws holding the post in place were sheared off. The post was placed back into its proper location, but not secured in place. The test continued with the pallet being raised using additional support. No further damage was noted.

D. INCLINE-IMPACT TEST. The incline-impact plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact until all four sides had been tested. For the second impact, the pallet was oriented laterally. The front skid came loose from two of the three posts. Once again, the screws were sheared off. The skid that came loose in this test was not the same skid that came loose during the drop test. No further damage was noted during the remainder of the test.

E. END OF TEST INSPECTION. The smooth surface on the deck of the pallet was slightly roughed up at some locations. No other damage was noted.

TEST SAMPLE NO. 2:

A. GENERAL. This pallet is constructed of polyethylene. The skids and the deck boards were fastened to the posts by 2-1/2-inch no. 12 screws. The the deck boards were fastened to the stringer boards by 1-1/2-inch no. 12 screws. A 1-1/2- by 1/4- by 47-inch steel strip was attached to the bottom of each skid by countersunk 1/4-inch flathead bolts which were 1-1/2-inches long.

B. SUPERIMPOSED LOAD TEST. The polyethylene pallet was initially loaded to 13,700 pounds compression. The compression was released after one hour. No damage was noted during this test.

C. REPETITIVE SHOCK TEST. The duration of the test was 90 minutes for each orientation of the pallet. For the lateral orientation, the transportation simulator was initially set for 182 rpm. For the longitudinal orientation, the transportation simulator was initially set for 238 rpm. The top of the polyethylene skid was warm near one corner of the pallet. This was caused by a bolt going through the skids not being completely countersunk in the steel strip. No damage was noted as a result of the vibration or the heat from the bolt not being countersunk.

D. EDGEWISE ROTATIONAL DROP TEST. One side of the pallet was placed on a beam 4-1/2 inches high. The other side on the pallet was raised to a height of 12 inches, then dropped. This process was repeated until all four sides of the pallet had been dropped. The wings of the pallet were bent upward as a result of the drops. No further damage was noted.

E. INCLINE-IMPACT TEST. The incline-impact plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been impacted. No damage was noted as a result of the impacts.

F. END OF TEST INSPECTION. The smooth surface on the deck of the pallet was slightly roughed up at some locations. Along two sides, some melting of the polyethylene deck occurred. The melting was not significant enough to cause failure. No other damage was noted.

TEST SAMPLE NO. 3:

A. SUPERIMPOSED LOAD TEST. The polyethylene pallet with oak skids was initially loaded to 13,700 pounds compression. The compression was released after one hour. No damage was noted during this test.

B. REPETITIVE SHOCK TEST. The duration of the test was 90 minutes for each orientation of the pallet. For the lateral orientation, the transportation simulator was initially set for 185 rpm. For the longitudinal orientation, the transportation simulator was initially set for 265 rpm. No damage to the pallet was noted during this test.

C. EDGEWISE ROTATIONAL DROP TEST. One side of the pallet was placed on a beam 4-1/2-inches high. The other side of the pallet was raised to a height of 12 inches, then dropped. This process was repeated until all four sides of the pallet had been dropped. No damage was noted during this test.

D. INCLINE-IMPACT TEST. The incline-impact plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been impacted. A small piece of the outside wing split off during the first longitudinal impact. No further damage was noted as a result of the impacts.

E. END OF TEST INSPECTION. The smooth surface on the deck of the pallet was slightly roughed up at some locations. Along two sides, some melting of the polyethylene occurred. The melting was not significant enough to cause failure. No other damage was noted.

HEAT SOAK TEST: (TEST SAMPLE NO. 2):

A. SUPERIMPOSED LOAD TEST. The polyethylene pallet was exposed to a heat soak of 140 degrees Fahrenheit for a period of 24 hours prior to the compression test. The pallet was initially loaded to 13,800 pounds compression. The compression was released after one hour. Upon removal of the pallet from the compression table, it was noted that two screws holding the polyethylene skid to the pallet posts were loose. No further damage was noted during this test.

B. REPETITIVE SHOCK TEST. Prior to each orientation of vibration, the pallet was exposed to a heat soak of 24 hours at 140 degrees Fahrenheit. The duration of the test was 90 minutes for each orientation of the pallet. For the lateral orientation, the transportation simulator was initially set for 225 rpm. A band broke at the end of the vibration in the lateral direction, causing part of the load to shift off the pallet. The load was reassembled. For the longitudinal orientation, the transportation simulator was initially set for 240 rpm. No damage to the pallet was noted during this test.

C. EDGEWISE ROTATIONAL DROP TEST. Immediately preceding the drop test, the pallet was exposed to 24 hours of heat soak at 140 degrees Fahrenheit. One side of the pallet was placed on a beam 4-1/2-inches high. The other side of the pallet was raised to a height of 12 inches, then dropped. This process was repeated until all four sides of the pallet had been dropped. No damage was noted during this test.

D. INCLINE-IMPACT TEST. The incline-impact test immediately followed the drop test with no further heat soak exposure to the pallet occurring. The incline-impact plane was set to

allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact. After the second impact, the pallet was being slung when it was noted that one of the corner posts had worked loose from the pallet deck. It was also noted that the other posts attached to that skid had separated from the deck by 1/4-inch. The heat soak had caused the plastic around the screw to become soft enough to allow the screw to pull out of the post. No further impacts were performed.

HEAT SOAK TEST (MODIFIED TEST SAMPLE NO. 2):

A. GENERAL. Pallet no. 2 was modified as follows: A 1/4-inch flathead turnbuckle 5 inches long was placed from the top of the deck to the bottom of the skid through each post for outside skids. For the center skid, the turnbuckle extended from the top of the stringer board to the bottom of the skid through each post.

B. SUPERIMPOSED LOAD TEST. Immediately prior to compression, the polyethylene pallet was exposed to a heat soak of 140 degrees Fahrenheit for a period of 24 hours. The pallet was then initially loaded to 13,800 pounds compression. The compression was released after one hour. No further damage was noted during this test.

C. REPETITIVE SHOCK TEST. Prior to each orientation of vibration, the pallet was exposed to a heat soak of 140 degrees Fahrenheit for a period of 24 hours. The duration of the test was 90 minutes for each orientation of the pallet. For the lateral orientation, the transportation simulator was initially set for 212 rpm. For the longitudinal orientation, the transportation simulator was initially set for 216 rpm. No damage to the pallet was noted during this test.

D. EDGEWISE ROTATIONAL DROP TEST. The pallet was subjected to a heat soak of 140 degrees Fahrenheit for a period of 24 hours. Upon removal of the pallet from the heat soak,

one side of the pallet was placed on a beam 4-1/2-inches high. The other side of the pallet was raised to a height of 12 inches, then dropped. This process was repeated until all four sides of the pallet had been dropped. No damage was noted during this test.

E. INCLINE-IMPACT TEST. The incline-impact test immediately followed the drop test with no further heat soak exposure to the pallet. The incline-impact plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been impacted. No damage to the pallet was noted during this test.

F. END OF TEST INSPECTION. Expansion of the polyethylene portion of the skid created a gap exceeding 3/4-inch between the bottom of the polyethylene skid and the top of the metal strip attached to the skid. While this gap does not cause failure of the pallet, it is cause for concern. A forklift tine could get caught under the skid and break it.

COLD SOAK TEST (TEST SAMPLE NO. 4):

A. GENERAL. This pallet was constructed in the same manner as modified test sample no. 2 with the following exceptions: The flathead turnbuckle used at each block extends from the top of the polyethylene stringer board to the bottom of the polyethylene skid, not the top of the deck to the bottom of the skid. Also, an additional countersunk 1/4-inch diameter screw 1-inch long was placed through the metal strip into the polyethylene skid between each set of consecutive blocks.

B. SUPERIMPOSED LOAD TEST. The pallet was exposed to a cold soak of 16 hours. The supply of carbon dioxide ran out during the soak period, and the soak temperature had risen from -40 degrees Fahrenheit to 20 degrees Fahrenheit upon removal. The pallet was initially

loaded to 13,900 pounds compression. The compression was released after one hour. No further damage was noted during this test.

C. REPETITIVE SHOCK TEST. The pallet was placed in a soak temperature of -40 degrees Fahrenheit for a period of 2 hours immediately upon the completion of the compression. For the lateral orientation, the transportation simulator was initially set for 200 rpm for 90 minutes. At the end of the lateral vibration, the pallet was again soaked at -40 degrees Fahrenheit for a period of 2 hours. For the longitudinal orientation, the transportation simulator was initially set for 150 rpm for 90 minutes. No damage to the pallet was noted during this test.

D. EDGEWISE ROTATIONAL DROP TEST. The pallet was soaked overnight, initially at 0 degrees Fahrenheit, raising to 45 degrees Fahrenheit by morning. The pallet was then soaked an additional 5 hours at -40 degrees Fahrenheit prior to the drop test. One side of the pallet was placed on a beam 4-1/2-inches high. The other side of the pallet was raised to a height of 12 inches, then dropped. This process was repeated until all four sides of the pallet had been dropped. No damage was noted during this test.

E. INCLINE-IMPACT TEST. The incline-impact test immediately followed the drop test with no further cold soak endured by the pallet. The incline-impact plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been impacted. No damage to the pallet was noted during this test.

F. END OF TEST INSPECTION. The pallet completed testing with one of the outside deck boards broken between two of the blocks. While the pallet was still loaded, it was placed

in the heat soak to observe the amount of bowing present in the skid. The separation between the polyethylene skid and the metal strip was reduced to 1/4-inch.

COLD SOAK TEST (REPAIRED PALLET NO. 4):

A. GENERAL. The deck board that was broken in the previous set of tests was removed and a deck board from test sample no. 2 was used to replace the broken deck board.

B. SUPERIMPOSED LOAD TEST. The pallet was exposed to a cold soak of -40 degrees Fahrenheit for a period of 4.5 hours. Upon removal, the pallet was placed under 16,900 pounds compression. After 1 hour, the compression was released with no damage occurring to the pallet.

C. REPETITIVE SHOCK TEST. The pallet was placed in the chamber overnight that was initially -15 degrees Fahrenheit and was 37 degrees Fahrenheit by morning. The pallet was exposed to a cold soak of -40 degrees Fahrenheit for a period of 3 hours and 15 minutes. Following the cold soak, the pallet was vibrated in the longitudinal orientation for a period of 90 minutes resulting in no damage to the pallet. The pallet was then cold soaked for another 2 hours followed by 90 minutes of vibration in the lateral orientation. Three bands broke during this orientation due to wear caused by the bands rubbing against the beam to hold the pallet on the table. The bands were replaced. No damage occurred to the pallet.

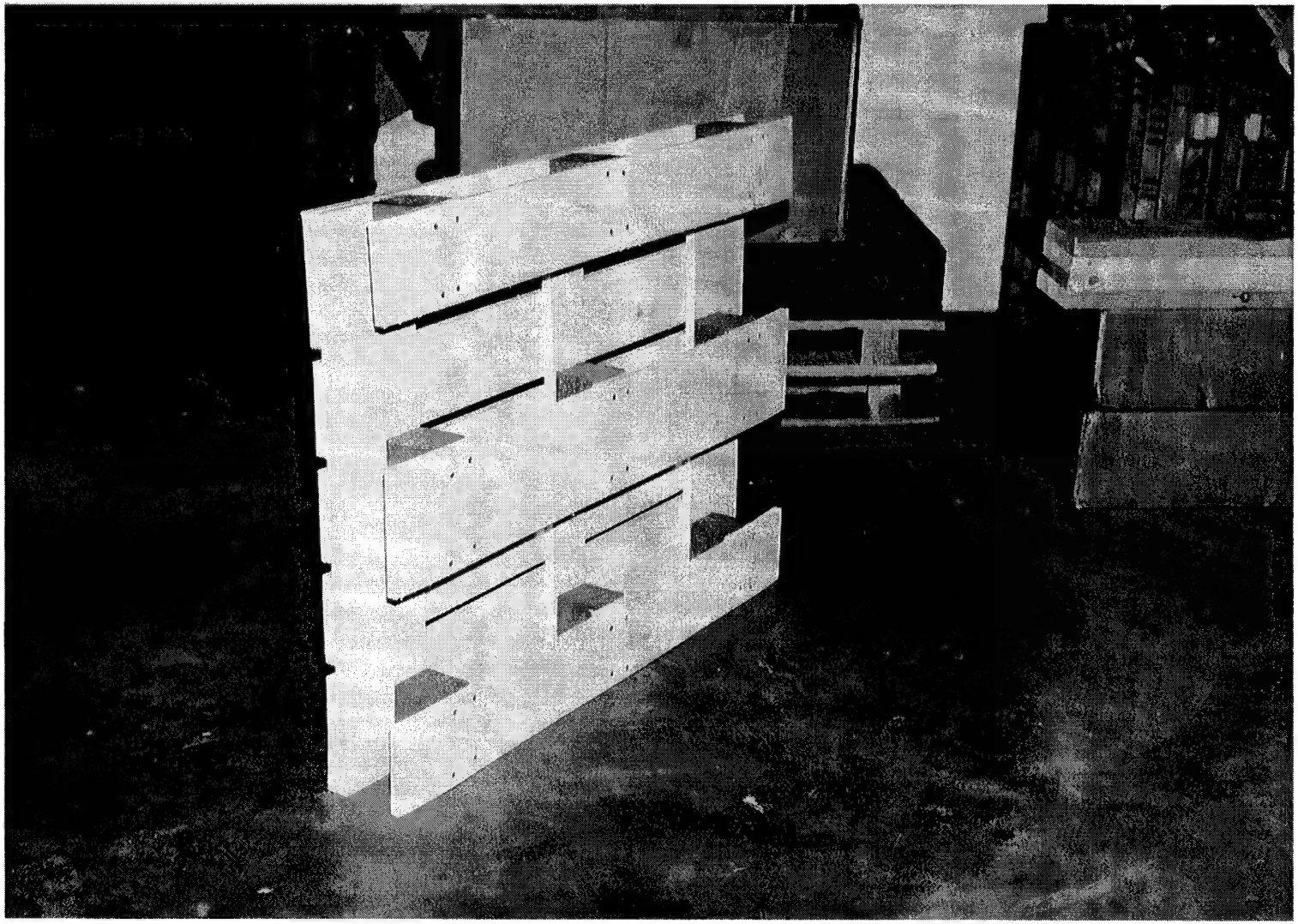
D. EDGEWISE ROTATIONAL DROP TEST. The pallet was cold soaked overnight to a morning temperature of 30 degrees Fahrenheit. The pallet then recieved a -40 degrees Fahrenheit soak for 4 hours 40 minutes. One side of the pallet was placed on a beam 4-1/2 inches high while the other side of the pallet was raised to a height of 12 inches, then dropped. The process was repeated until all four sides were dropped. No damage to the pallet resulted.

E. INCLINE-IMPACT TEST. The incline-impact test immediately followed the drop test with no further cold soak occurring. The incline-impact plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact until all four sides had been impacted. No damage to the pallet was noted during this test.

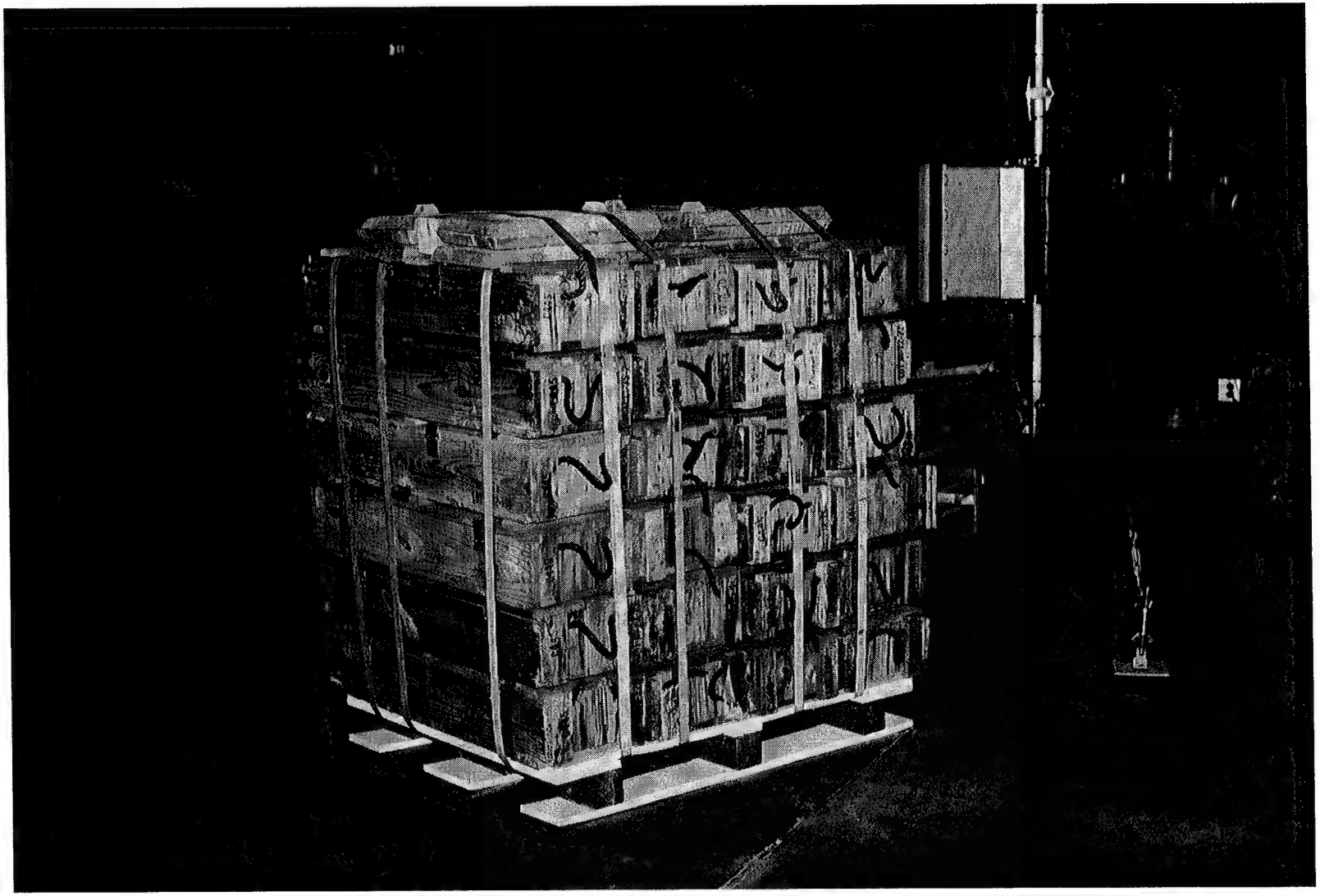
F. END OF TEST INSPECTION. After the load was removed from the pallet, the pallet was inspected. No damage was evident. The pallet passed MIL-STD-1660 criteria with cold soak.

PART 6

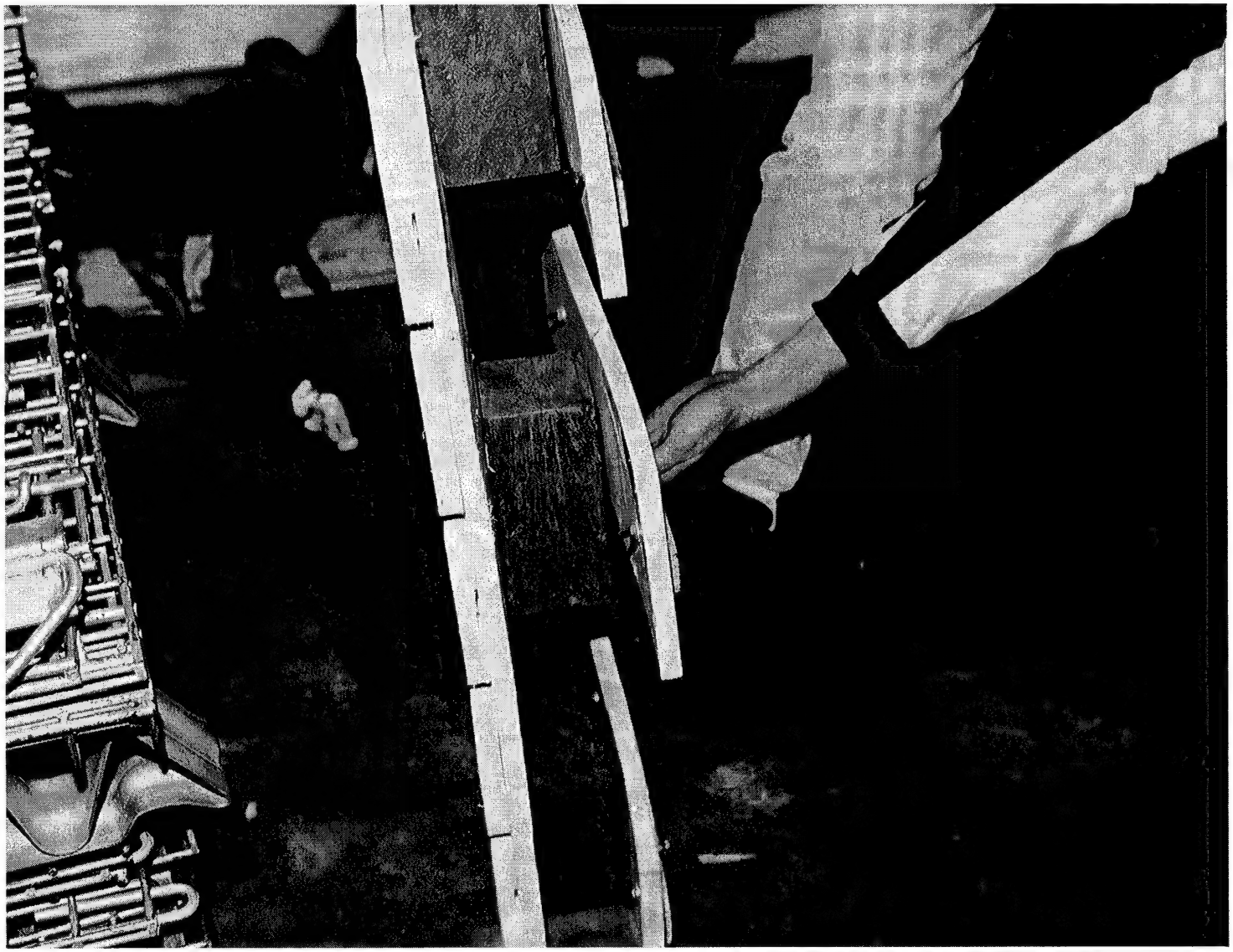
PHOTOGRAPHS



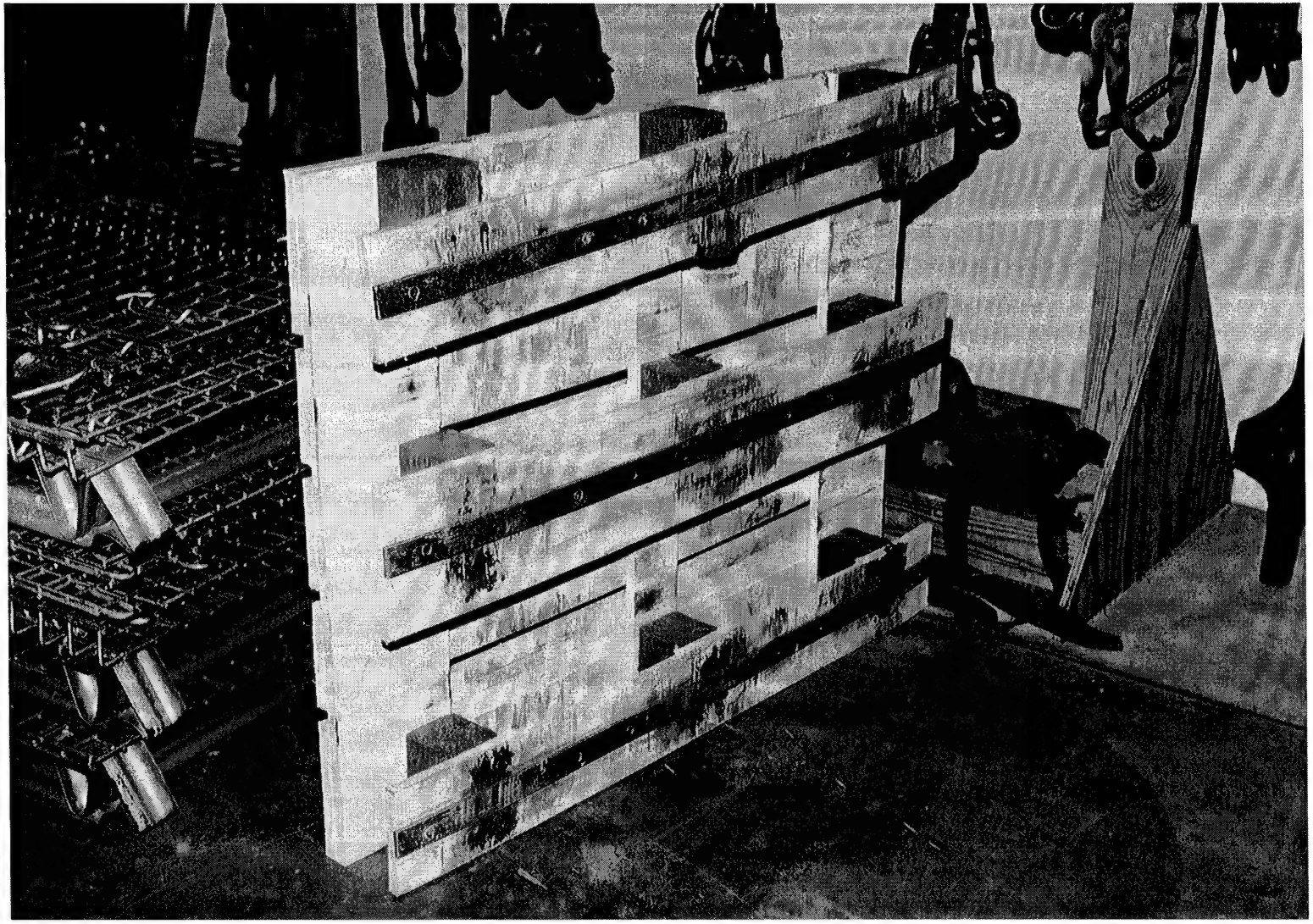
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-106-1338. This photo shows pallet no. 1 prior to testing. No metal strips are attached to the bottom of the skids.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-106-1335. This photo shows the test load on pallet no. 1. The weights are banded to the top of the load to create a 4,000-pound load.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-126-1348. This photo shows the skid detached from the post. The screws attaching the skid sheared off.		



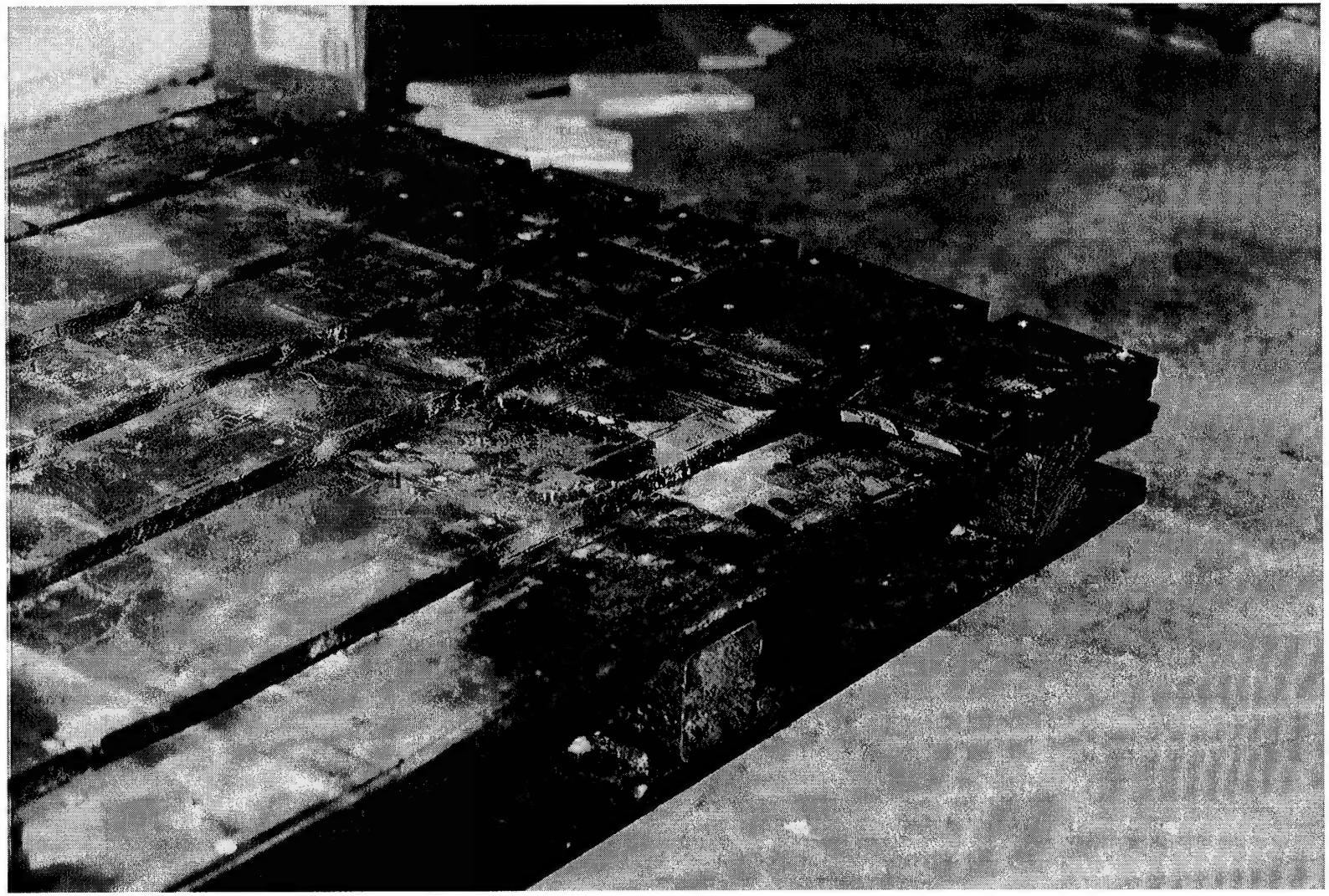
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-126-1347. This photo shows the outside skid detached from 2 of the 3 posts. The screws fastening the skid to the post sheared off. Note melting of the polyethelyne skid that occurred prior to the addition of the metal strips.		

	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-106-1342. This photo shows pallet no. 2 prior to testing.		

	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-123-1302. This photo shows the load on pallet no. 2. Two of the boxes contain lead weights to achieve a 4,000-pound load.		

	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-126-1344. This photo shows pallet no. 3 prior to testing. Note the oak skids used in place of the plastic skids with steel strip attached.		

	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-126-1340. This photo shows the load on pallet no. 3. Two boxes contain weights to achieve a 4,000-pound load.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-2565. This photo shows pallet no. 4 following cold soak testing. The outside deckboard cracked during testing.		

	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-2571. This photo shows the repaired pallet no. 4 following MIL-STD-1660 cold soak testing. No significant damage occurred.		

PART 7

APPENDIX

TECHNICAL DATA

PROPERTY	METRIC	PROPERTY	FT ⁻ POUND SYSTEM
Weight 12mm Sheet kg (2440 x 1220 mm)	35	Weight 1/2" Sheet lb (96" x 48")	77
Weight/m^2 (12mm Sheet) kg	11.8	Weight/ft^2 (1/2" Sheet)	2.4
Density kg/m^3	920	Density lb/ft^3	57.5
*Tensile Strength N/mm^2	8.42	Tensile Strength lb/in^2	1200
*Tensile Modulus N/mm^2	288	Tensile Modulus lb/in^2	41800
*Elongation at Break %	23	Elongation at Break %	23
**Flexural Yield Strength N/mm^2	9.08	Flexural Yield Strength lb/in^2	1310
**Flexural Modulus N/mm^2	295	Flexural Modulus lb/in^2	42800
***Unnotched Charpy Impact kJ/m^2		Unnotched Charpy Impact ft lb/in^2	
Strength 12mm	66	Strength 1/2 in	31
Strength 6mm	31	Strength 1/4 in	15
+Thermal Conductivity W/mK	33	Thermal Conductivity BTU $in/hf^2°F$	2.3
+Thermal Conductivity U Value W/m^2K	4.7	Thermal Conductivity U Value	33
++Linear Thermal Expansion mm/m/°C	0.226	Linear Thermal Expansion 0.001"/ft/°F	1.5
Surface Spread Flame (BS476 Part 1 1971)	Class 3	Surface Spread Flame (BS476 Part 1 1971)	Class 3

* BS 2782 Method 320C: 1976
** BS 2782 Method 335A: 1978
*** BS 2782 Method 351A: 1977
\+ BS 874 1973
++ ASTM D 696-79

Note: All figures are approximate

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POLYMER PROFILES

Technical Information

Physical Properties

Density (lb/ ft ^{3})	57-60
Compressive Strength (p.s.i.)	3500
E value (Structural Sizes)	
Load up to 200 lb	88,000
Load up to 400 lb	71,000
Load up to 600 lb	61,000
Load up to 800 lb	51,000
Load up to 1,000 lb	43,000

Based on three point bending tests. Distance between supports 42".

Resistance to Attack

Unaffected by:

Alkalis and acids at temperatures up to 150° F
Most organic solvents at ambient temperature
Rot
Insects
Fungus

General Properties

Can be worked like wood - resembles dense wood
Does not splinter like wood
Electrical insulator

Pull - Out Tests

4" Bolts	1200 lb.
6" Lag Bolts	2000 lb.

Ring Shank Nails

24 Rings Embedded	600lb.
20 Rings Embedded	490lb.
16 Rings Embedded	360lb.

Bolt specimens prepared by drilling 1/8" pilot hole before driving bolt.

Nail specimens prepared by driving nails with no pre-drilled hole.

PULLOUT TESTS

Designation	Ultimate Load (lbs)	Failure Description
Small Screws		
P1	1420	Slight slip at 1110 pounds - screw release
P2	1160	Screw release
Large Lag Bolts		
P3	1990	Slip at 1110 and 1640 tension failure in specimen - bolts did not release
P4	2100	Bolt pulled out of product
Large Nails		
N1	627	Factory prepared - 24 rings on the nail embedded
N2	490	Lab prepared - 20 rings embedded
N3	363	Lab prepared - 16 rings embedded